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Abstract

This paper quantifies the impact of public employment on local labor markets in the long-run. We adopt two quantitative approaches and apply them to the case of Spanish cities. In the first, we develop a 3-sector (public, tradable and non-tradable) search and matching model embedded within a spatial equilibrium model. We characterize the steady state of the model, which we calibrate to match the labor market characteristics of the average Spanish city. The model is then used to simulate the local labor market effects of expanding public sector employment. In the second empirical approach, we use regression analysis to estimate the effects of public sector job expansions on decadal changes (1980-1990 and 1990-2001) in the employment and population of Spanish cities. This analysis exploits the dramatic expansion of public employment that followed the advent of democracy in the period 1980 to 2001. The instrumental variables' approach that we adopt uses the capital status of cities to instrument for changes in public sector employment. The two empirical approaches yield qualitatively similar results and, thus, cross-check each other. One additional public sector job creates about 1.3 jobs in the private sector. However, these new jobs do not translate into a substantial reduction in the local unemployment rate as better labor market conditions attract new workers to the city. Increasing public employment by 50% only reduces unemployment rate from 0.156 to 0.150.

JEL Classifications: J45, J64, H70, R12.

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1 Introduction

Public employment constitutes a significant fraction of employment. In 2013, the share of public employment in total employment was, on average, 21.3% in OECD countries[1]. Hence, policies regarding public sector wages and employment are likely to influence the labor market. The objective of this study is to estimate the long-run labor market effects of public employment at the city-level.

There is evidence from different countries indicating that governments use public employment as a policy tool to affect local labor market performance. Specifically, governments use the distribution of public employment within their countries' geography as a means to reduce spatial economic inequalities. In 1992, up to 400,000 jobs in public works in East Germany cushioned the rise in unemployment that followed re-unification (Kraus et al., 1998). In Spain, jobs in public works have been created in rural and lagging areas as a means to increase local disposable income (Jofre-Monseny, 2014). In Sweden, the creation of universities in less prosperous cities has formed part of the country's regional policy to reduce regional economic disparities (Andersson, 2005). In England, 25,000 public sector jobs were relocated away from London between 2004 and 2010. Among other objectives, the policy aimed at stimulating economic activity in less prosperous areas (Faggio and Overman, 2014). Less explicitly, interregional income redistribution has partly been achieved through a higher concentration of public sector jobs in the south, both in Italy (Alesina et al., 2001) and in Spain (Marqués-Sevillano and Rosselló-Villallonga, 2004). Focusing on risk sharing between Norwegian regions, Borge and Matsen (2004) show that public employment is a prominent force for counterbalancing local economic shocks.

Increasing the number of public employees in a city increases the demand for local services such as housing, restaurants and hair-dressers, crowding-in private employment. However, this effect may be offset by increases in local wages and prices that might follow the public employment expansion. This crowding-out effect can be particularly acute in the tradable sector since local workers do not significantly affect the demand for locally produced manufactures. In addition, local job creation can increase in-migration rates, which might also weaken the link between more jobs in the local economy and a lower unemployment rate among its residents.

To quantify the long-run local labor market effects of public employment, we adopt two quantitative approaches that we apply to the case of Spanish cities. In the first, we calibrate and simulate a search and matching model with geographically mobile workers. In the second, we resort to regression analysis. These two empirical approaches yield qualitatively similar results and, thus, cross-check each other.

We first develop a 3-sector (public, tradable and non-tradable) search and matching model à la Diamond (1982)-Mortensen (1982)-Pissarides (1985). The model assumes that (homogeneous) workers only search for work when are unemployed and that they accept any job offered.

[1] OECD (2015).

Moreover, unemployed workers can move at zero cost. It is assumed that each city is sufficiently small, implying a fixed reservation utility for the unemployed. Workers consume all their income on a tradable good, a non-tradable good and land. The latter two prices are endogenous and clear their respective markets while the price of the tradable good is exogenous and determined in the national (or international) market. Due to geographical mobility, a city whose labor market prospects improve is a city that must become more expensive to live-in. Vacancies and wages in the public sector are exogenously determined while, in the private sector, free-entry means that firms in the tradable and non-tradable sectors open up vacancies until the expected value becomes zero.

We characterize the steady state of the model, which we then calibrate to match the labor market characteristics of the average Spanish city. Then, we use the model to simulate the local labor market effects of expanding public sector employment. The geographical mobility of workers implies that the labor force in the city increases with public sector job expansion. In the non-tradable sector, the wage increase resulting from the policy is clearly offset by the rise in local demand for the non-tradable good, and employment in this sector increases substantially. In contrast, the demand for the locally produced tradable good remains unaffected. As a result, the effect on tradable employment is small, being determined by two opposing forces: higher wages, on the one hand, decrease employment, while agglomeration economies, on the other, which boost productivity, increase employment. In our baseline calibration, one additional public sector job increases private jobs by 1.3 and the workforce by 2.6 individuals. As a result, large expansions in public employment have only modest impacts on the local unemployment rate. Increasing public employment by 50% only reduces the unemployment rate from 0.156 to 0.149.

In the second empirical approach, we use regression analysis to estimate the effects of public sector job expansions on decadal changes (1980-1990 and 1990-2001) in the employment and population of Spanish cities. This analysis exploits the dramatic increase in public employment that followed the advent of democracy after Franco's death. Between 1980 and 2001, public employment grew by 133%, increasing from 1.4 to 3.2 million jobs. We start by analyzing the determinants of this public sector job expansion across cities. Two important results emerge. First, more public sector jobs were created in cities experiencing negative labor demand shocks, providing further evidence that public employment is used by governments to reduce spatial income inequalities. Second, the provincial capitals (established in 1833) experienced a more than proportionate increase in public employment between 1980 and 2001. Specifically, being a capital city implied an additional 1.6 public sector jobs each decade per 100 inhabitants in the base year. This result is the basis for our Two Stage Least Squares (TSLS) strategy which consists in using the capital status of cities to instrument for changes in public sector employment. As for instrument validity, several robustness checks support the assumption made that (conditional on initial unemployment, education, location -coast versus inland cities- and size) the capital status of a city is uncorrelated to shocks in employment and population growth. The TSLS estimates also indicate that one additional public sector job increases private jobs by about 1.3 and the labor force by 2.7 individuals. The reduced-form estimates obtained imply that increasing public employment by 50% only reduces the unemployment rate from 0.156 to 0.150.

There are, at least, three factors that serve to rationalize the relatively large multipliers that we find. First, in the period that we study (1980-2001), interregional migration rates in Spain were relatively low but, in contrast, intraregional migration rates were substantial (Bover and Arellano, 2001). Specifically, cities continued to attract migrants from the rural areas within their region and more public sector jobs in the capital cities might have intensified this process. Second, the model simulations indicate that land supply elasticity is critical in determining if, and the extent to which, public employment crowds-in or crowds-out private employment. The complier cities in our TSLS regressions are relatively small provincial capitals which can be considered as being cities with a rather elastic land supply. Finally, our model also indicates that multipliers are greater when public sector wages are high. In Spain, the public sector wage gap is substantial (Hospido and Moral-Benito, 2014), and this is especially true in small provincial capitals given that the distribution of public sector wages is more compressed than that of the private sector.

The paper that is closest to ours is Faggio and Overman (2014), who estimate the local labor market effects of public employment in England. Their main results, based on 2003-2007 employment changes at the English Local Authority level, indicate that public employment neither increases nor decreases overall private employment, although the industry mix is changed in favor of the non-tradable sector. When examining a longer time horizon (1999-2007), their results suggest that, if anything, public employment crowds-out rather than crowds-in private employment. As Faggio and Overman (2014) recognize, the highly restrictive planning system prevalent in England (Hilber and Vermeulen, 2015) implies a very inelastic land (and housing) supply which could explain the absence of significant crowding-in effects on private employment in that country. We complement the study conducted by Faggio and Overman (2014) in several ways. First, we estimate the local labor market effects of public employment in Spanish cities. For the reasons detailed above, these estimates can be policy-relevant in settings with unrestrictive planning systems and/or with favorable geography for urban development. Second, we study a time period in which the Spanish public sector developed, with massive, geographically heterogeneous increases in public employment. While in the period studied by Faggio and Overman (2014), public employment in England increased by less than 6%, in our setting there was an increase of 133%. Third, we develop a search and matching model with geographical mobility that clarifies the mechanisms through which public employment affects cities and quantifies their relative importance. Finally, another attractive feature of our study is the novel TSLS strategy that we use. Instead of using a Bartik (1991) shift-share instrument that uses employment in the base year to predict subsequent employment growth, we use a city feature (the capital status of a city) that dates back to 1833 to predict public employment growth in the decades of 1980-1990 and 1990-2001. As we document that more public jobs are created in cities experiencing negative labor demand shocks, building a shift-share instrument with the 1980 and 1990 distribution of public employment could be problematic as these distributions may reflect past labor demand shocks, which are likely to be correlated over time.

Instead of analyzing the local labor market effects of public employment, Moretti (2010) and Moretti and Thulin (2013) estimate the local multipliers of jobs in the tradable sector in the US and Sweden, respectively. Their results indicate that, on average, one additional job in the tradable sector creates about 1.6 and 0.5 jobs in the non-tradable sector in the typical US and Swedish city, respectively. Our results, therefore, lie in between these two estimates, but are closer to the US multipliers.

Beaudry et al. (2012)[2], Kline and Moretti (2013) embed standard search and matching models à la Diamond-Mortensen-Pissarides in spatial equilibrium models (Roback, 1982)[3]. Beaudry et al. (2012) set-up a multi-sector, multi-city model with labor market frictions. The empirics of the paper, which examines changes in wages and employment across cities and industries in the US, indicate that a positive labor demand shock in one sector increases wages in the rest of the city's industries, providing empirical support for labor market frictions and bargaining. In a similar vein, Kline and Moretti (2013) examine the efficiency of place-based policies in the presence of geographical mobility and labor market frictions. In relation to these studies, we go a step further by calibrating the model and using it to simulate the effects of a local labor market policy. To the best of our knowledge, we are the first to do so in the context of search and matching models with geographical mobility.

Finally, our paper also relates to a recent strand of the macro literature studying the labor market effects of public employment in national economies. Burdett (2012), Gomes (2015a) and Bradley et al. (2016) use search and matching models to analyze the effects of public sector wages and employment on labor market performance[4]. The conclusions reached regarding the effects of public employment are much more negative than those obtained in the present study. Algan et al. (2002) also study the effects of public employment at the national level using regression analysis applied to a long OECD country-level panel. Their results also suggest strong crowding-out effects. Specifically, they indicate that one public job crowds-out 1.5 private sec-

[2]Beaudry et al. (2014) extend the search and bargaining model previously developed in Beaudry et al. (2012) to allow for agglomeration and congestion externalities. This paper considers, theoretically and empirically, the joint determination of local wages, employment and unemployment rates, housing prices, and city size.

[3]A related study is Wrede (2015), which extends the urban economics literature on the measurement of quality of life by considering the presence of unemployment.

[4]Quadrini and Trigari (2007) and Gomes (2015b) are concerned instead with the effect of public employment on the volatility of labor market outcomes.

tor jobs and increases the number of unemployed by 0.3 individuals. Our study differs from this strand of the literature in that it estimates the effects at the city (rather than at the national) level. Two facts can reconcile our results with those of this literature. First, labor mobility across cities implies that labor supply is much more elastic at the city than at the national level. In fact, in our search and matching model, if we consider the case with no geographical mobility, public employment also crowds-out private employment. Second, at the city level, the public wage bill is not financed through local taxes as it is typically financed by some upper-tier government.

The remainder of this paper is organized as follows. In section 2 we develop the theoretical model. Section 3 presents the calibration of the model (3.1) and the main results of the model simulations (3.2). Section 4 contains the regression analysis. We describe the data and variables (4.1) before providing the institutional background and analyzing the city-level determinants of the public sector job expansion (4.2). Then, we turn to a descriptive (Ordinary Least Squares) analysis of the effects of public employment on the city's private employment and population (4.3) before proceeding to the main TSLS analysis (4.4). The effects of public employment on the local unemployment rate are addressed in section 4.5 and, finally, section 5 concludes.

2 The model

In this section we develop a search and matching model à la Diamond-Mortensen-Pissarides embedded within a spatial equilibrium model following Beaudry et al. (2012) and Kline and Moretti (2013). Homogeneous workers can be either employed or unemployed. Employees can be either in the public sector (g), in the tradable sector (t) or in the non-tradable sector (n). Workers consume all their income on a tradable good, a non-tradable good and land. Unemployed workers can leave the city at no cost.

2.1 Employment and unemployment

Unemployed workers search for jobs in the three sectors simultaneously and enjoy the non-labor income b[5]. We assume that the public sector is frictionless and job vacancies are instantaneously filled. We assume that the public sector wage bill is not financed through local taxation since the lion's share of this expenditure is financed by central and regional governments. We further assume that the public sector job creation rate (f_g), separation rate (s_g) and wage (w_g), are all exogenously determined. In the private sector, jobs are filled via a constant returns to scale matching function, $m(uL, vL) = m_o u^{\chi} v^{(1-\chi)} L$, where u is the unemployment rate, v the vacancy rate and L is the labor force of each city, while χ and m_o are the elasticity and scale matching function parameters, respectively. Unemployed workers find jobs in the tradable and

[5]This technology of search is labelled as undirected search in Acemoglu (2001).

non-tradable sectors at the endogenous rates $f_i(\theta) = \frac{m(uL,vL)}{uL}\Omega_i$, where Ω_i represents the fraction of vacant jobs in each sector with $i = t, n$, i.e. $\Omega_i = \frac{v_i}{v_t+v_n}$. In turn, vacancies in the private sector are filled at rate $q(\theta)$, where θ represents the tightness of the private labor market in the city (vacancies-unemployment ratio), $\theta \equiv \frac{v_t+v_n}{u} \equiv \frac{v}{u}$[6]. According to the properties of the matching function, the higher the number of vacancies with respect to the number of unemployed workers, the easier it is to find a job, $f'(\theta) > 0$, and the more difficult it is to fill a vacancy, $q'(\theta) < 0$.

The jobs in the tradable and non-tradable sectors can be either filled or vacant. Before a position is filled, the firm has to open a job vacancy with a flow cost k_i. Private firms have a technology with labor as the only input. Each filled job in the tradable sector yields instantaneous profit equal to the difference between the marginal productivity of labor and the wage. The price of the tradable good is exogenous and normalized to one as tradable goods are sold in national (or international) markets, implying that the instantaneous profit amounts to $A_t(L) - w_t$. We consider that productivity increases with city size due to agglomeration economies[7]. Specifically, the marginal productivity of labor is given by $A_t(L) = A_{t_0}L^{\zeta}$, where $0 < \zeta < 1$ and A_{t_0} captures the exogenous technological level in the tradable sector. In turn, the instantaneous profit of the non-tradable sector is equal to $p_n - w_n$, which increases with the (endogenous) price of the non-tradable good, p_n[8]. Employed workers in the tradable and non-tradable sectors separate from their firm at the (sector-specific) constant rate s_i.

Thus, the value of vacancies V_t and V_n, and the value of a job in the tradable and non-tradable sectors, J_t and J_n, are represented by the following Bellman equations:

$$rV_t = -k_t + q(\theta)(J_t - V_t), \tag{1}$$

$$rV_n = -k_n + q(\theta)(J_n - V_n), \tag{2}$$

$$rJ_t = A_t(L) - w_t + s_t(V_t - J_t), \tag{3}$$

$$rJ_n = p_n - w_n + s_n(V_n - J_n). \tag{4}$$

Firms in the tradable and non-tradable sectors will open vacancies until the expected value of vacancies becomes zero. Thus, the free entry condition in these two sectors are:

[6]By the homogeneity of the matching function this ratio is not a function of L.

[7]See Combes and Gobillon (2015) for a recent review of the empirics of agglomeration economies.

[8]We do not consider agglomeration effects in the non-tradable sector as there is less room for productivity increases in that sector (Moretti (2012), p.57).

$$rV_t = 0, \tag{5}$$

$$rV_n = 0. \tag{6}$$

2.2 Workers

Each worker consumes a tradable and a non-tradable good, and land. Hence, a worker's utility in a city depends on their nominal income, $y = \{b, w_g, w_t, w_n\}$ as well as on the city's prices of the non-tradable good (p_n) and land (p_c)[9]. We assume that workers have a Cobb-Douglas utility function which delivers indirect utility $V(y, p_n, p_c) = y\left(1-\phi-\delta\right)^{(1-\phi-\delta)}\left(\frac{\phi}{p_n}\right)^{\phi}\left(\frac{\delta}{p_c}\right)^{\delta} = \frac{y}{P}$, defining P as the city's price index[10].

$$P = \left(\frac{1}{1-\phi-\delta}\right)^{(1-\phi-\delta)}\left(\frac{p_n}{\phi}\right)^{\phi}\left(\frac{p_c}{\delta}\right)^{\delta}. \tag{7}$$

The parameters ϕ and δ reflect workers' preferences for the non-tradable good and land, respectively, as well as being the income shares spent on these two goods. The values for unemployment (U) and employment in the public (W_g), tradable (W_t) and non-tradable (W_n) sectors are given by the following expressions:

$$rU = \frac{b}{P} + f_g(W_g - U) + f_t(W_t - U) + f_n(W_n - U), \tag{8}$$

$$rW_g = \frac{w_g}{P} + s_g(U - W_g), \tag{9}$$

$$rW_t = \frac{w_t}{P} + s_t(U - W_t), \tag{10}$$

$$rW_n = \frac{w_n}{P} + s_n(U - W_n). \tag{11}$$

[9]Note that we do not consider non-participation in the labor market. As the regression results in section 4 show, the results do not indicate that public employment in a city increases labor force participation.

[10]In our model, having more public employees in the city does not increase the provision of local public goods and services and, thus, it does not increase city amenities. We take this modeling approach because, as will become clear below, public employees in capital cities provide public goods and services (administrative services, universities and hospitals) that clearly do not only benefit the city's residents.

We assume that unemployed individuals can move to another city at zero cost, implying that the utility of unemployed workers is equalized across cities. Since we assume that each city is small relative to the whole economy, the value of unemployment is fixed at z. Alternatively, if we consider intraregional migrations between the city and its hinterland, z would be the utility level achieved in the city's hinterland.

$$rU = z, \tag{12}$$

Taking equations 8 and 12 implies that, in equilibrium, if the labor market prospects of a city improve (high wages, high job finding rates and/or low job separation rates), then the city must become a more expensive place to live-in (higher price index).

The next assumption is that wages in the tradable and non-tradable sectors are set through Nash bargaining. The Nash solution is the wage that maximizes the weighted product of the worker's and firm's net return from the job match. The first-order condition from this maximization problem is[11]:

$$\frac{1}{P}\beta J_t = (1-\beta)(W_t - U), \tag{13}$$

$$\frac{1}{P}\beta J_n = (1-\beta)(W_n - U), \tag{14}$$

where the parameter β represents the worker's bargaining power.

To fully characterize the dynamics of this economy, we need to define the law of motion for the unemployment rate (u), and for the employment rates in the public (e_g), tradable (e_t) and non-tradable (e_n) sectors. These evolve according to the following differential equations:

$$\dot{u} = s_g\, e_g + s_t\, e_t + s_n\, e_n - f_g\, u - f_t\, u - f_n\, u, \tag{15}$$

$$\dot{e_g} = f_g\, u - s_g\, e_g, \tag{16}$$

$$\dot{e}_t = f_t u - s_t\, e_t, \tag{17}$$

[11]The derivation of equations 13 and 14 are presented in Appendix A.

$$\dot{e_n} = f_n u - s_n e_n, \tag{18}$$

$$e_g + e_t + e_n + u = 1. \tag{19}$$

Notice that the levels of unemployment and employment in the public, tradable and non-tradable sectors are uL, $e_g L$, $e_t L$ and $e_n L$, respectively.

In order to close the model, the markets for the non-tradable good and land must clear. The non-tradable good must be purchased by local workers.

$$\phi(w_g e_g + w_t e_t + w_n e_n + b\,u) = p_n e_n. \tag{20}$$

Finally, we assume that land rents accrue to absentee land owners and, following Combes et al. (2016a), we assume that land price is increasing with city size according to:

$$p_c = L^{\eta}. \tag{21}$$

2.3 Equilibrium

In equilibrium, the system of equations can be reduced to the following twelve key equations that characterize the behavior of the endogenous variables θ, f_t, f_n, p_n, p_c, w_t, w_n, e_t, e_n, L, A_t and u:

$$\frac{k_t}{q(\theta)} = \frac{A_t(L) - w_t}{(r + s_t)}, \tag{22}$$

$$\frac{k_n}{q(\theta)} = \frac{p_n - w_n}{(r + s_n)}, \tag{23}$$

$$w_t = \beta A_t(L) + \big((1-\beta)b + \beta\theta(\Omega_t k_t + \Omega_n k_n)\big)\frac{(r + s_g)}{(r + s_g + f_g)} + \frac{f_g(1-\beta)w_g}{(r + s_g + f_g)}, \tag{24}$$

$$w_n = \beta p_n + \big((1-\beta)b + \beta\theta(\Omega_t k_t + \Omega_n k_n)\big)\frac{(r + s_g)}{(r + s_g + f_g)} + \frac{f_g(1-\beta)w_g}{(r + s_g + f_g)}, \tag{25}$$

$$u=\frac{s_g s_t s_n}{[s_t s_n s_g + s_g s_t f_n + s_g f_t s_n + f_g s_t s_n]}, \tag{26}$$

$$e_g=\frac{f_g}{s_g}u, \tag{27}$$

$$e_t=\frac{f_t}{s_t}u, \tag{28}$$

$$e_g+e_t+e_n+u=1, \tag{29}$$

$$\frac{1}{P}\left[b+\frac{f_g}{(r+s_g+f_g)}(w_g-b)+\frac{(r+s_g)\beta(\Omega_t k_t+\Omega_n k_n)}{(r+s_g+f_g)(1-\beta)}\theta\right] = z, \tag{30}$$

$$\phi(w_g e_g+w_t e_t+w_n e_n+b\,u)=p_n e_n, \tag{31}$$

$$p_c = L^{\eta}, \tag{32}$$

$$A_t(L)=A_{t_0}L^{\zeta}. \tag{33}$$

Equations 22 and 23 are the standard job creation curves that characterize the marginal condition for the demand of labor in the tradable and non-tradable sectors, respectively. More jobs are created if wages, vacancy costs and labor market tightness are low and if marginal revenue ($A_t(L)$ or p_n) is high. Equations 24 and 25 are the respective wage curves that replace the labor supply curves of Walrasian models (Pissarides (2000), page 17)[12]. As in Beaudry et al. (2012), frictions and bargaining result in wages in the private sector that depend on the wage and on the job finding and job separation rates in the public sector[13]. In turn, equations 26 to 29 characterize the unemployment rate and the employment rates in the public, tradable and non-tradable sectors in steady state. Equations 30, 32 and 33 appear as a consequence of workers' mobility. Equation 30 relates the unemployment value (z) to the city's land price and job market prospects, while 32 and 33 specify the rate at which the land price and productivity in the tradable sector increase with city size. Finally, equation 31 guarantees that the local price of the non-tradable good clears the market.

We are interested in analyzing the effects of an increase in public employment in contexts

[12] The derivation of equations 24 and 25 are provided in Appendix B.

[13] If there is no public employment ($f_g = s_g = 0$), the wage equations reduce to their standard form (Pissarides (2000), p.18). Specifically, $w_t = \beta A_t(L) + (1-\beta)b + \beta\theta(\Omega_t k_t + \Omega_n k_n)$ and $w_n = \beta p_n + (1-\beta)b + \beta\theta(\Omega_t k_t + \Omega_n k_n)$.

in which public wages are relatively high. Increasing the job creation rate in the public sector, f_g, has two main effects on private employment rates. On the one hand, according to wage equations 24 and 25, a higher f_g impacts positively w_t and w_n as wages are determined trough a bargaining process. Firms react to higher wages by posting fewer vacancies (equations 22 and 23) which will push employment rates down. On the other hand, a higher public wage bill will increases local income and the demand of locally produced non-tradable goods, increasing the output value of this sector (equation 31). Since w_n has increased, equation 23 indicates that output value per worker can only increase if p_n also increases, which raises profits and, therefore, the non-tradable employment rate. In turn, the improved labor market prospects in the city attracts workers, increasing local land prices (equation 32). Equation 30 pins down the exact relationship between better labor market prospects and the city price index P. As for the tradable sector, note that the employment rate need not decrease as a larger city entails higher productivity in the sector due to agglomeration economies (equation 33). Finally, it is important to emphasize that the employment rate effects discussed above can markedly differ from employment level effects due to changes in city size.

3 Calibration and simulated results of the model

3.1 Calibration

We calibrate the model to match the labor market characteristics of the average Spanish city with transition rates defined at quarterly frequencies. Table 1 summarizes all the calibrated parameters and presents the steady state values of the endogenous variables. The real interest rate is fixed at $r = 0.012$, which is consistent with an annual interest rate of 4.8%. We target the 2001 city averages in terms of the unemployment rate (15.6%) and the employment rates in the public sector (20.9%), the tradable sector (15.8%) and the non-tradable sector (47.7%). Using the Spanish Labor Force Survey (SLFS) and adopting the methodology applied in Silva and Vázquez-Grenno (2013), we calculate the separation rates in the three sectors considered. While the separation rate in the public sector is $s_g = 0.009$, in the tradable and non-tradable sectors these rates are higher and virtually identical with $s_t = s_n = 0.015$. Combining the job separation rates, the employment rates and the unemployment rate with $\dot{e_g} = \dot{e_t} = \dot{e_n} = \dot{u} = 0$ delivers the job finding rates $f_g = 0.012$, $f_t = 0.015$ and $f_n = 0.046$.

Since we do not observe vacant jobs, to calibrate the model, we assume that the fraction of job vacancies in each of the two private sectors (Ω_i) is given by the observed employment shares. Thus, we set $\Omega_t = 0.249$ and $\Omega_n = 0.751$. This implies that the aggregate job finding rate in the private sector is $f = f_t + f_n = 0.061$. We normalize the labor market tightness to one, $\theta = 1$. Once Ω_n, u and θ are known, we obtain the vacancy rates for the tradable and non-tradable sectors using $\Omega_n = \frac{v_n}{v_t + v_n}$ and $\theta = \frac{v_t + v_n}{u}$. We obtain $v_t = 0.039$ and $v_n = 0.117$ and, thus, $v = v_t + v_n =$

0.156. Finally, the vacancy filling rate is $q(\theta) = \frac{f(\theta)}{\theta} = 0.061$. Pissarides and Petrongolo (2001) identify the matching function elasticity parameter as being in the 0.5-0.7 range. We take 0.6 as our reference and, thus, we set $\chi = 0.6$. Given that we know the job finding rates and θ, we can then use $f = m_o\theta^{1-\chi}$ to obtain the matching function scale parameter $m_o = 0.061$.

As for wages, we normalize the wage in the public sector to one ($w_g = 1$). Following Hospido and Moral-Benito (2014), we target a wage gap of 20% between the public and private sectors. Similarly, we estimate the wage gap between the tradable and the non-tradable sectors using the Spanish Continuous Sample of Working Lives in 2005 (*Muestra continua de Vidas Laborales*, MCVL). We find a gap of 11.9% after controlling for individual characteristics (age, age square, gender and education), leaving us with $w_t = 0.913$ and $w_n = 0.807$.

According to Eurostat, labor productivity in the Spanish tradable sector was 45.7% higher than personnel costs[14]. Thus, we set labor productivity at $A_t(L) = w_t * 1.457 = 1.331$. As for agglomeration economies, Ciccone and Hall (1996) and Rosenthal and Strange (2008) find an elasticity of (total factor) productivity with respect to density of around 4-5%[15]. One concern with these studies is that highly-skilled workers are positively selected into the largest cities, thus over-estimating the effect of city size on productivity (Combes and Gobillon, 2015). Therefore, we set this elasticity at 3%, i.e. $\zeta = 0.03$. We normalize the labor force to one ($L = 1$) which implies $A_{o_t} = 1.331$ given equation 33 and $p_c = 1$ given equation 32. We assume that η, the elasticity of the land price with respect to city size, is 0.70 as the midpoint of the range that has been recently estimated by Combes et al. (2016a).

The last two parameters determined by data are the income shares spent on the non-tradable good and land. For the former share, we use data from the Household Budget Survey (HBS) for 2006. We set the share of income that workers spend on the non-tradable good (ϕ) at 0.6[16]. In order to determine the income share spent on land, we multiply the income share dedicated to housing by the share of land in housing values. We set the first quantity at 0.293, which is in between to the values reported for the US by Davis and Ortalo-Magne (2011) and for France by Combes et al. (2016a)[17]. The second quantity, the share of land in housing values, is directly available from the BBVA capital stock series. This quantity closely follows the Spanish housing periods of boom and bust. We take 0.233, the average value for the pre-boom period (1995-1998), which is very similar to the estimates reported by Albouy (2009) and Combes et al.

[14] 2008-2010 average from Eurostat - Structural Business Statistics.

[15] The studies quantifying the effect of (log) density on (log) productivity (or wages) typically include, as a regressor, the city's land surface. Hence, the elasticity of density is also the elasticity of city size.

[16] It is not always obvious whether to classify household expenditure as tradable or non-tradable spending at the city level. In general, we consider services to be non-tradable goods.

[17] Imputed rents from the Living Conditions Survey (LCS) look abnormally low in Spain. We take rental values from a leading listing website (*Fotocasa*). In 2012, the average rent was 7.220 euros a month per square meter. The average dwelling in Spain is $90.6m^2$ (2011 Population and Housing Census) which gives us an annual rent of 7,850 euros. If we take the average household income in Spain (26,775 euros according to LCS), we obtain a share of income spent on housing of 0.293.

(2016b) for the US and French economies, respectively. The product of these two quantities is very close to 7% and, thus, we set $\delta = 0.07$. The income share spent on tradable goods is thus obtained as $1-\phi-\delta$ which amounts to 0.33.

Knowing w_t, $A_t(L)$, $q(\theta)$, r and s_t, we can use 22 to find the vacancy cost in the tradable sector k_t. There are no other variables or parameters that can be identified by a single equation. The price of the non-tradable good, p_n, along with the parameters b (non-labor income), β (the workers' bargaining power), z (the value of unemployment) and k_n (the vacancy cost in the non-tradable sector) are jointly determined by equations 23, 24, 25, 30 and 31.

Table 1: Calibrated parameter values

Parameters	Value	Source/Target
Interest rate, r	0.012	Data
Separation rate public sector, s_g	0.009	SLFS
Separation rate tradable sector, s_t	0.015	SLFS
Separation rate non-tradable sector, s_n	0.015	SLFS
Matching function elasticity parameter, χ	0.600	(Pissarides and Petrongolo, 2001)
Matching function scale parameter, m_o	0.061	Matching function
Wage public sector, w_g	1.000	Normalization
Exogenous productivity tradable sector, A_{to}	1.331	Eurostat & $L = 1$
Agglomeration economies' elasticity, ζ	0.030	(Combes and Gobillon, 2015)
Land cost to city size elasticity, η	0.700	(Combes et al., 2016a)
Non-tradable good income share, ϕ	0.600	HBS
Land income share, δ	0.070	LCS, BBVA & *Fotocasa*
Workers' bargaining power, β	0.313	Solves 23, 24, 25, 30 and 31
Non-labor income, b	0.315	Solves 23, 24, 25, 30 and 31
Unemployment utility, z	0.308	Solves 23, 24, 25, 30 and 31
Vacancy cost tradable sector, k_t	0.944	Solves 22
Vacancy cost non-tradable sector, k_n	0.415	Solves 23, 24, 25, 30 and 31
Variables		
Public employment rate, e_g	0.209	2001 Census
Tradable employment rate, e_t	0.158	2001 Census
Non-tradable employment rate, e_n	0.477	2001 Census
Unemployment rate, u	0.156	2001 Census
Labor market tightness, θ	1.000	Normalization
Wage tradable sector, w_t	0.913	MCVL
Wage non-tradable sector, w_n	0.807	MCVL
Labor force, L	1.000	Normalization
Job finding rate public sector, f_g	0.012	Solves 27
Job finding rate tradable sector, f_t	0.015	Solves 28
Job finding rate non-tradable sector, f_n	0.046	Solves 29
Land price, p_c	1.000	Solves 32
Productivity tradable sector, A_t	1.331	Eurostat & $L = 1$ & Solves 33
Non-tradable good price, p_n	0.990	Solves 23, 24, 25, 30 and 31

3.2 Simulated results

Table 2 presents the simulated results of the model with a job creation policy scenario that targets increases of 25, 50 and 100% in the level of public employment, Le_g. The size of these public employment increases is consistent with the public sector employment expansions observed in Spanish cities in the period 1980-2001. These scenarios correspond to increases in the public job finding rate, f_g, from 0.012 to 0.014, 0.015 and 0.017, respectively.

Increasing public employment in a city implies a higher demand for the non-tradable good. However, expanding public employment with well paid jobs increases local private wages and, thus, employment in the non-tradable sector may either increase or decrease. The simulations indicate that the demand effect clearly dominates the wage effect. Specifically, one public sector job creates between 1.2 and 1.3 jobs in the non-tradable sector. In contrast, an increase in public employees does not raise the demand for locally produced tradable goods. As a result, the effect on tradable employment is smaller and is determined by two opposing forces: higher wages, on the one hand, decrease employment, while agglomeration economies, on the other, increase employment. In this sector, the simulations imply multipliers that are either positive but very small (0.013 to 0.001) or negative (-0.042).

Table 2 also indicates that an increase in the number of public jobs in the city increases the size of its labor force. These effects are substantial. An additional public job increases the city's labor force by 2.4 to 2.7 workers. A larger city increases the price of land as well as the price of the non-tradable good. This higher cost-of-living (the price index P) offsets better labor market prospects. The population inflow weakens the link between more jobs and a lower unemployment rate in the city. For instance, increasing public employment by 50% only reduces the unemployment rate from 0.156 to 0.149. Similarly, if we focus on employment rates instead of employment levels, the local labor market effects of public employment are not so positive. If we take the scenario of a 50% increase in public employment, the share of workers employed in the private sector actually falls. While the employment rate in the non-tradable sector increases very little (by 0.003), the employment rate in the tradable sector falls by 0.034, which is very similar the increase in the employment rate in the public sector (i.e. 0.037). The same picture occurs if we examine the job finding rates. In the tradable sector, the rate falls from 0.015 to 0.013, while in the non-tradable sector it increases from 0.046 to 0.048. The same pattern is found with the vacancy rate (the sum of the vacancy rates in the tradable and non-tradable sectors) which falls more than the unemployment rate and, as a consequence, labor market tightness actually decreases.

Table 2: Benchmark simulated results with an increase in public employment

	f^g	θ	f_t	f_n	p_n	p_c	w_t	w_n	Le_g	Le_t	Le_n	L	u
Baseline													
	0.012	1.000	0.015	0.046	0.990	1.000	0.913	0.807	0.209	0.158	0.477	1.000	0.156
25% increase in public employment													
	0.014	0.994	0.014	0.047	0.997	1.096	0.920	0.814	0.261	0.159	0.546	1.140	0.152
Multipliers										**0.027**	**1.322**	**2.688**	
50% increase in public employment													
	0.015	0.988	0.013	0.048	1.003	1.184	0.926	0.820	0.314	0.158	0.611	1.273	0.149
Multipliers										**0.001**	**1.282**	**2.606**	
100% increase in public employment													
	0.017	0.979	0.010	0.050	1.012	1.341	0.935	0.830	0.419	0.149	0.734	1.521	0.144
Multipliers										**-0.042**	**1.221**	**2.478**	

Note: Multipliers are calculated as the employment or labor force change divided by the employment increase in the public sector.

3.3 Alternative simulations of the model

In this section we present model simulations for two alternative scenarios. First, we consider the model without geographic mobility. Second, we study the relationship between the size of the multipliers and the magnitude of the public sector wage gap.

3.3.1 The model without labor mobility

We consider the model with a fixed city size ($L = 1$), which implies that the productivity in the tradable sector and the price of land are fixed. Since there is no mobility, it is no longer true that $rU = z$. In terms of the equations that characterize the equilibrium, we drop equations 30, 32 and 33[18]. Table 3 shows the simulated results with an increase in the public job creation rate from 0.012 to 0.020 (a 50 % increase in the level of public employment).

Table 3: Simulated results without labor mobility across cities

	f^g	θ	f_t	f_n	p_n	p_c	w_t	w_n	Le_g	Le_t	Le_n	L	u
Baseline													
	0.012	1.000	0.015	0.046	0.990	1.000	0.913	0.807	0.209	0.158	0.477	1.000	0.156
50% increase in public employment													
	0.020	0.925	0.006	0.053	1.008	1.000	0.934	0.832	0.314	0.059	0.488	1.000	0.139
Multipliers										**-0.944**	**0.105**	**0.000**	

Note: Multipliers are calculated as the employment change divided by the employment increase in the public sector.

In stark contrast with the case considered above in which geographic mobility was considered, public employment clearly crowds-out private employment. While one extra job in the public sector destroys about 0.9 jobs in the tradable sector, it only creates 0.1 jobs in the non-tradable sector. As discussed above, the tradable sector is more negatively affected than the non-

[18]As shown in Appendix B, the wage equations are obtained without using the condition $rU = z$.

tradable sector as an increase in the number of public employees does not increase the demand for locally produced tradable goods. Since one public sector job destroys less than one job in the private sector, unemployment is reduced, falling from 0.156 to 0.139. In this scenario, the link between more public sector jobs and less unemployment is not weakened by the inflow of workers but rather by the destruction of private sector jobs. Considering a closed economy brings the results of the simulations much more closely in line with those of the macroeconomics literature analyzing the impact of public employment on (national) labor markets (Burdett (2012), Gomes (2015a), Bradley et al. (2016) and Algan et al. (2002)).

These simulations show that whether public employment crowds-in or crowds-out private employment depends crucially on the extent to which city size increases following a public employment expansion. In fact, even if workers are mobile, public employment can not trigger an inflow of workers if land supply is very inelastic, which results in public employment crowding-out private jobs. Indeed, the simulations (not reported here for reasons of space) indicate that the elasticity of land price with respect to city size (η), together with the income share spent on land (δ), are the key parameters governing whether (and the extent to which) public employment crowds-in or crowds-out private employment.

3.3.2 Size of multipliers and the public wage premium

We simulate two alternative scenarios that differ in the size of the wage gap between the public and the private sectors. In each scenario, we recalibrate the model maintaining the rest of the targets and simulating the effect of an increase in public employment of 50%. First, we reduce the public sector wage gap to 10% while, later, we increase it to 30%. The baseline scenario (Table 2, row 2) is reproduced here in the second row for ease of comparison, and it corresponds to a public sector wage gap of 20%. Table 4 shows the simulated results.

Table 4: Simulation results: Size of multipliers and the public wage premium

	f^g	θ	f_t	f_n	p_n	p_c	w_t	w_n	Le_g	Le_t	Le_n	L	u
50% increase in public employment & 10% public wage gap													
	0.016	0.990	0.012	0.049	1.082	1.141	1.007	0.892	0.314	0.138	0.578	1.207	0.146
Multipliers										**-0.191**	**0.964**	**1.969**	
50% increase in public employment & 20% public wage gap (Table 2, second row)													
	0.015	0.988	0.012	0.048	1.003	1.184	0.926	0.820	0.314	0.158	0.611	1.273	0.149
Multipliers										**0.001**	**1.282**	**2.606**	
50% increase in public employment & 30% public wage gap													
	0.014	0.988	0.013	0.048	0.934	1.214	0.856	0.759	0.315	0.171	0.634	1.319	0.151
Multipliers										**0.124**	**1.484**	**3.013**	

Note: Multipliers are calculated as the employment or labor force change divided by the employment increase in the public sector.

The simulations indicate that higher public sector wages increase the positive multiplier effects of public employment. Increasing the public wage gap from 10 to 30% increases the estimated employment multipliers from -0.2 to 0.1 in the tradable sector, and from 1.0 to 1.5 in the non-tradable sector. Similarly, the labor force multiplier increases from 2.0 to 3. This result is consistent with the findings reported in Moretti (2010) and Moretti and Thulin (2013). Specifically, they find multipliers from the tradable to the non-tradable sectors that are especially high when the jobs in the tradable sector command high wages. Here, too, the effects of public employment on private employment are quite sensitive to the public sector wage gap.

4 Reduced-form estimates: Evidence from the late development of the Spanish public sector: 1980-2001

In this section, using regression analysis, we estimate the city-level effects of public sector job expansions. To that end, we exploit the uneven geography of the substantial increase in public sector employment that took place in Spain in the period 1980-2001 following the advent of democracy. Since we are interested in the long-run effects of public employment (changes between steady states in terms of the model developed above), we examine decadal changes (1980-1990 and 1990-2001) in the employment and population of Spanish cities. This exercise enables us to assess the degree to which the simulated results of the model match carefully estimated reduced-form coefficients. This section is organized as follows. After describing the data and variables used in the analysis, we provide a description of the geography of the expansion of public sector jobs. Then, we report Ordinary Least Squares (OLS) estimates before turning to the main instrumental variable analysis that uses a city's capital status as an instrument for local public sector employment growth.

4.1 Data and variables

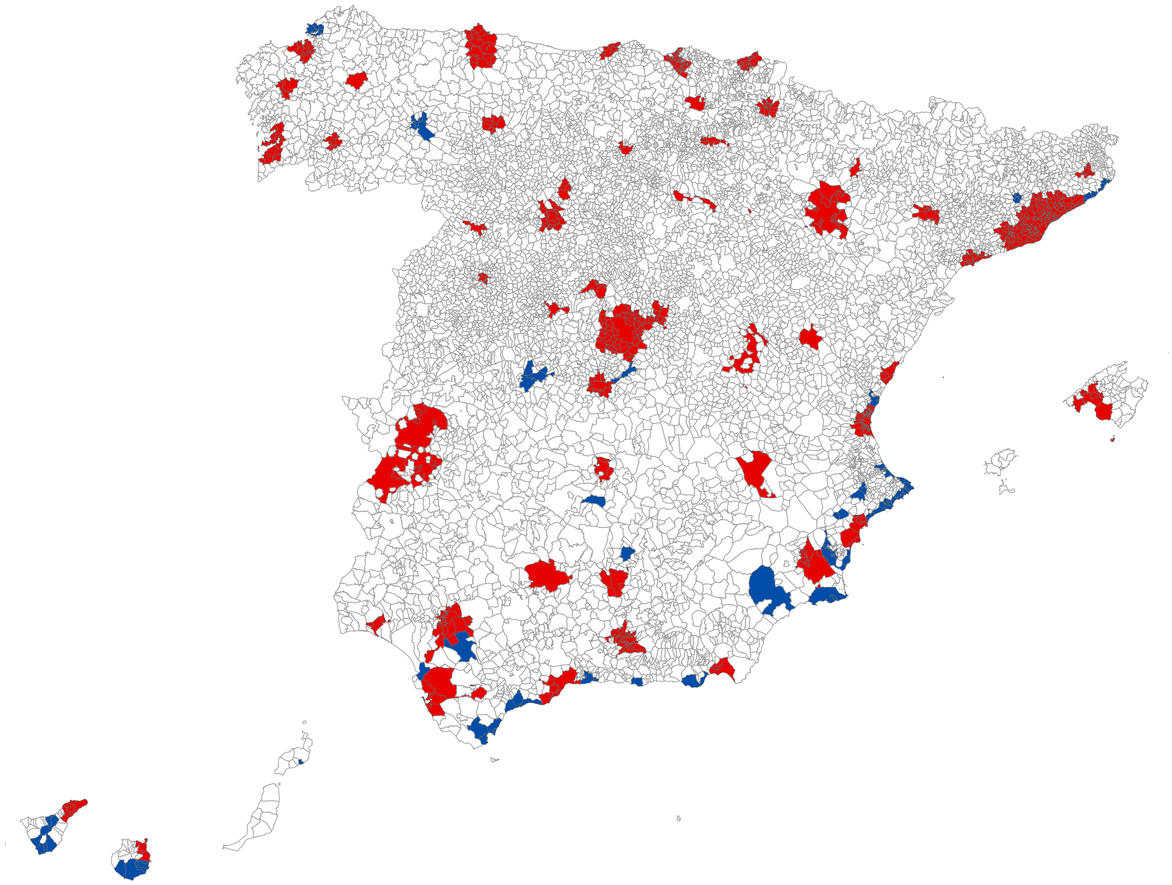
We draw primarily on Census data on employment and population. In the case of employment, the data are drawn from Censuses of Establishments carried out in 1980, 1990 and 2001, which contain counts of employees by municipality and by the main economic activity (2-digit level) of the establishment in which the employee works. In the case of population, we use population counts by labor market status from the 1981, 1990 and 2001 Population Censuses. We also have access to some data on employment and population from the 1970 Censuses. We then construct city-wide counts of these variables using the 2008 urban area definitions built by the Ministry of Housing[19]. We work with a total of 83 cities (urban areas) whose locations and extensions are shown in Figure 1. In 2001, these cities concentrated 67% of the population[20]. The median city (Ourense) had 126,410 inhabitants in 2001. The size of the two largest cities - Madrid (5,135,225)

[19]The same definitions are used in De la Roca and Puga (2016).

[20]We do not consider Ceuta and Melilla, the two Spanish enclaves in North Africa.

and Barcelona (4,391,196)- exceeds that of Soria (35,151) and Teruel (33,158) -the smallest two- by a factor of one hundred.

Figure 1: Urban areas (cities) in Spain



Source: Cities (urban areas) in 2008 -*Ministerio de la vivienda*. Capital cities (52) in red and non-capital cities (31) in blue. The map excludes *Menorca* (far east) and *La Palma*, *La Gomera* and *El Hierro* (far west) as no urban area is found in these islands.

Our public sector definition includes three industries: public administration (which includes the police and military forces), education and health. There are workers in the education and health sectors that are not public employees. Unfortunately, our data does not allow us to distinguish between private and public employees in these two activities. With this caveat in mind, we include the education and health sectors in our definition of the public sector for two reasons: First, because the majority of these workers are directly employed by governments (in 1999, 67 and 61% of the workers in education and health, respectively[21]); and, second, because there are many public services in education and health that, being partly financed by the public sector, are provided by private firms. The main instance of this is that of primary and secondary education where the teachers' salaries in the majority of privately run schools (so-called *Educación*

[21] These figures have been computed with the first term Labor Force Survey of 1999.

concertada) are paid by regional governments. Similar arrangements also exist in the health sector.

Total employment is the sum of employees in the public sector (E_g), the tradable sector (E_t) and the non-tradable sector (E_n)[22]. We assimilate the tradable sector with the manufacturing industries, while non-tradable employment contains the workers in private activities that produce goods that can not be traded and includes the construction sector[23]. Our model also predicts that public sector expansions increase city size. Thus, we also consider (changes in) the city-level (economically) active population, working age population and total population. Since in the model developed above all individuals are active in the labor market, the city size measure used there L corresponds more closely to active population.

In the regression analysis, we examine decadal (1980-1990 and 1990-2001) increases in the employment and population measures detailed above relative to the city population in the base year (1980 or 1990). The first two panels of Table 5 provide summary statistics for employment and population levels in 1980 and 2001 at the city level. The third panel reports summary statistics for the outcome variables that we examine below, namely, pooled employment and population decadal changes (1980-1990 and 1990-2001) relative to the population level at the beginning of the decade.

Starting with total population, the city average increased by 11.5% between 1980 and 2001. Since the sample is fixed over time (N=83), 11.5 is also the growth rate of the entire urban population in Spain. This figure exceeds 8.6%, the population growth experienced by Spain as a whole during this period, and indicates that the share of the population living in urban areas increased between 1980 and 2001. This higher growth experienced by cities is explained mostly by intraregional migrations from rural areas to cities (Bover and Arellano (2001) and Jofre-Monseny (2014)). Note that the average population growth rate over one decade (third panel) is 10.5%, which reveals that in Spain, small cities have grown more than large cities. In fact, mean reversion in population growth is a prevalent feature of our city-level data and one that needs to be taken into account in the regression analysis. The economically active population has grown far more (73%) in Spanish cities during this period as women entered the labor force en masse[24]. Similarly, (urban) employment increased by 86% between 1980 and 2001. This increase was not uniform across economic sectors as the economy experienced a process of tertiarization with employment in the tradable sector growing by only 6.6% between 1980 and 2001.

[22] We do not consider agriculture, farming and mining activities as they have been treated differently in different Censuses.

[23] Business services are clearly tradable goods. However, the 2-digit industry classification that is available to us does not often allow us to separate business vs. personal services within an industry code.

[24] According to the 1981 and 2001 Censuses, between these two years the participation rate of females aged 25-64 increased from 21 to 58%

Table 5: Employment and population in Spanish cities (1980-2001): Summary statistics

Variable	Mean	Median	SD	Min	Max
Employment and population levels in 1980 (N=83)					
Tradable employment	21,127	5,577	61,225	113	474,588
Non-tradable employment	30,026	10,625	75,550	1,551	513,539
Total employment	64,353	18,914	163,557	2,032	1,067,467
Active population	82,000	23,789	208,017	2,526	1,367,068
Working age population	180,138	52,284	428,575	10,672	2,812,315
Total population	296,136	96,763	689,109	18,022	4,546,343
Public employment	13,200	5,495	30,638	368	243,589
Employment and population levels in 2001 (N=83)					
Tradable employment	22,523	6,218	62,847	993	487,367
Non-tradable employment	67,688	23,003	172,171	5,397	1,252,375
Total employment	119,700	43,641	294,959	10,447	2,033,004
Active population	141,829	52,138	340,127	13,247	2,357,121
Working age population	228,056	87,123	520,014	19,828	3,609,102
Total population	330,320	126,410	747,146	31,158	5,135,225
Public employment	29,489	12,459	64,742	1,872	488,260
Employment and population decadal changes relative to the city's population in the base year (1980-1990 & 1990-2001 pooled changes, N=166)					
Tradable employment	0.005	0.005	0.019	-0.052	0.115
Non-tradable employment	0.061	0.052	0.041	-0.067	0.264
Total employment	0.095	0.089	0.058	-0.137	0.308
Active population	0.109	0.103	0.060	-0.119	0.356
Working age population	0.109	0.090	0.091	-0.029	0.584
Population	0.105	0.078	0.160	-0.088	0.959
Public employment	0.029	0.028	0.019	-0.031	0.093
Control variables: Pooled observations for 1980 and 1990 (N=166)					
Unemployment rate	0.181	0.170	0.061	0.042	0.406
Share of college graduates	0.080	0.079	0.032	0.024	0.170
Coast	0.446	0.000	0.499	0	1
Coast north	0.084	0.000	0.279	0	1
Share of vacation-homes in 1991	18.684	11.603	16.252	3.830	77.826
Total population in 1970	240,644	75,857	566,044	12,776	3,630,338

Note: Variables as defined in the main text.

4.2 The geography of public sector employment expansion

In Spain, the public sector developed at a surprisingly late date. Development started with the advent of democracy following Franco's death in 1975 and the introduction of the new constitution in 1978. While in 1980, the tax revenue to GDP ratio was only 22.6%, by 2001 this ratio had reached 33.9%[25]. This growth in the relative size of the public sector, combined with vigorous economic growth (the average annual real GDP growth rate between 1980 and 2001 was 2.95%) resulted in very large increases in public sector jobs. Table 6 shows the number of jobs in public administration, education and health in 1980, 1990 and 2001.

Table 6: Public sector jobs in Spain (1980-2001)

Year	Public sector	Public administration	Education	Health
1980	1,372,463	526,479	463,377	382,607
1990	2,114,351	816,514	665,896	631,941
2001	3,199,055	1,260,872	967,717	970,466

Source: Nationwide employment counts.

Between 1980 and 2001, there were job increases of 139, 109 and 154% in public administration, education and health, respectively. Taking the three sectors together, the increase in the number of public sector jobs during this period amounts to 133%, growing from 1.4 million in 1980 to almost 3.2 million jobs in 2001. For the three sectors making up the public sector as defined herein, public administration increased from 0.526 to 1.261 million jobs, the education sector rose from 0.463 to 0.967 million while employment in the health sector went from 0.382 to 0.970 million. In the urban areas studied here, the increase in public sector jobs was slightly lower than that recorded in Spain as a whole (123 versus 133%). This, coupled with the higher population growth of the urban areas, implies that public sector employment has grown disproportionately more in the non-urban areas of Spain.

Across cities, public sector jobs are also unevenly distributed. The size of the public sector is determined by and large by its administrative status. In Spain, there are provincial and regional capitals. Provinces (and the associated capitals) were established in 1833 by Javier de Burgos and constituted the main territorial division of the country until the advent of democracy. Although the provinces were not suppressed, 17 regions (*Comunidades Autónomas*) were built as aggregations of one or more provinces in 1981. Twenty years later, Spain was a decentralized country in which the spending of the *Comunidades Autónomas* amounted to roughly 46% of total government spending[26]. A similar picture is obtained if we look at the distribution of public employees across tiers of government. In 2001, regional governments employed 45% of public

[25] OECD Statistics.

[26] Excluding social security spending. See Carrión-i Silvestre et al. (2008) for a detailed explanation of the decentralization process.

employees whereas the central government and local governments employed the remaining 34 and 21%[27].

Figure 2 plots the presence of public employees in cities, distinguishing between regional and provincial capitals, and non-capital cities. With two exceptions (Santiago de Compostela and Mérida), the cities hosting regional governments are also provincial capitals[28]. Non-capital cities, such as El Ejido, Elda-Petrer and Torrevieja, have the lowest presence of public employees in 2001 with less than 5 employees per 100 inhabitants. At the other end of the scale, provincial capitals, such as Soria, Teruel, Ciudad-Real and Toledo, have more than 15 public employees per 100 inhabitants. More generally, this figure corroborates that being a capital is associated with public employees, and the difference is especially large for small cities. Holding population size constant, the presence of public employment is similar in provincial and regional capitals. This suggests that the process of regional decentralization that took place in Spain between 1981 and 2001 was not accompanied by a significant shift in public employment from provincial to regional capitals. On the contrary, pre-democratic provincial capitals kept their *status quo* in terms of public employment. On the one hand, provincial institutions (*Diputaciones* being the most prominent example) persisted into democratic Spain. On the other hand, provincial capitals managed to attract regional government public jobs. In the light of this, we only consider two types of city: capitals (regardless of their being provincial or regional) and non-capitals. There are 52 capital cities (50 provincial capitals in addition to Santiago de Compostela and Mérida) and 31 non-capital cities. Figure 1 shows the capital cities (in red) and non-capital cities (in blue) within Spain.

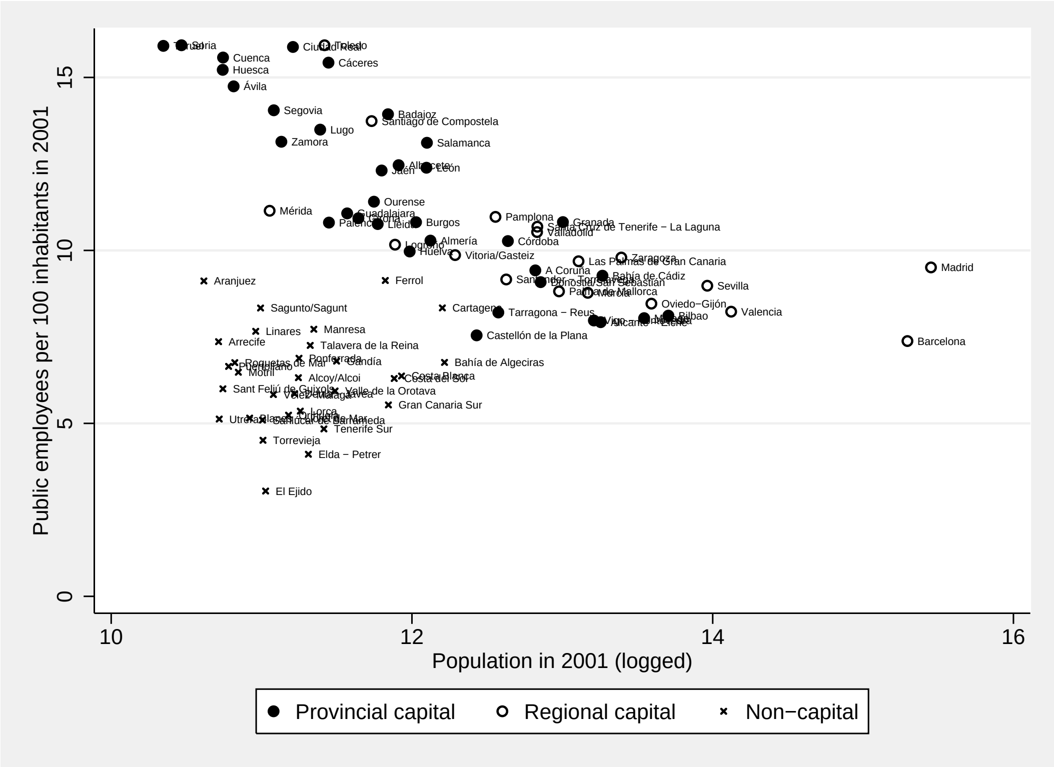
Figure 3 plots the (per capita) increase in public sector employment between 1980 and 2001 in the capital and non-capital cities. It shows that when public sector employment grew after the advent of democracy, growth was more pronounced in the capital cities, the differences being especially notable in small cities. The first row in Table 7 quantifies the (raw) over-representation of public employment in the capital cities. While the non-capital cities had 6.3 public sector workers per 100 inhabitants in 2001, the corresponding figure for the capital cities was 11.1. Although the difference is smaller in magnitude, per capita public sector workers also increased more in the capital cities between 1981 and 2001. The increase was 3.6 in non-capital cities vs. 5.1 in capital cities. Rows 1 to 4 in Table 7 show that the over-representation of public employment in capital cities, both in 2001 levels as well as in the changes between 1980 and 2001, occurred in public administration but also in the education and health sectors, as institutions like universities and hospitals also tend to concentrate in capital cities.

We now turn to a more systematic analysis of the city-level determinants of the public sector

[27] *Registro Central de Personal, Ministerio de Hacienda y de Administraciones Públicas.*

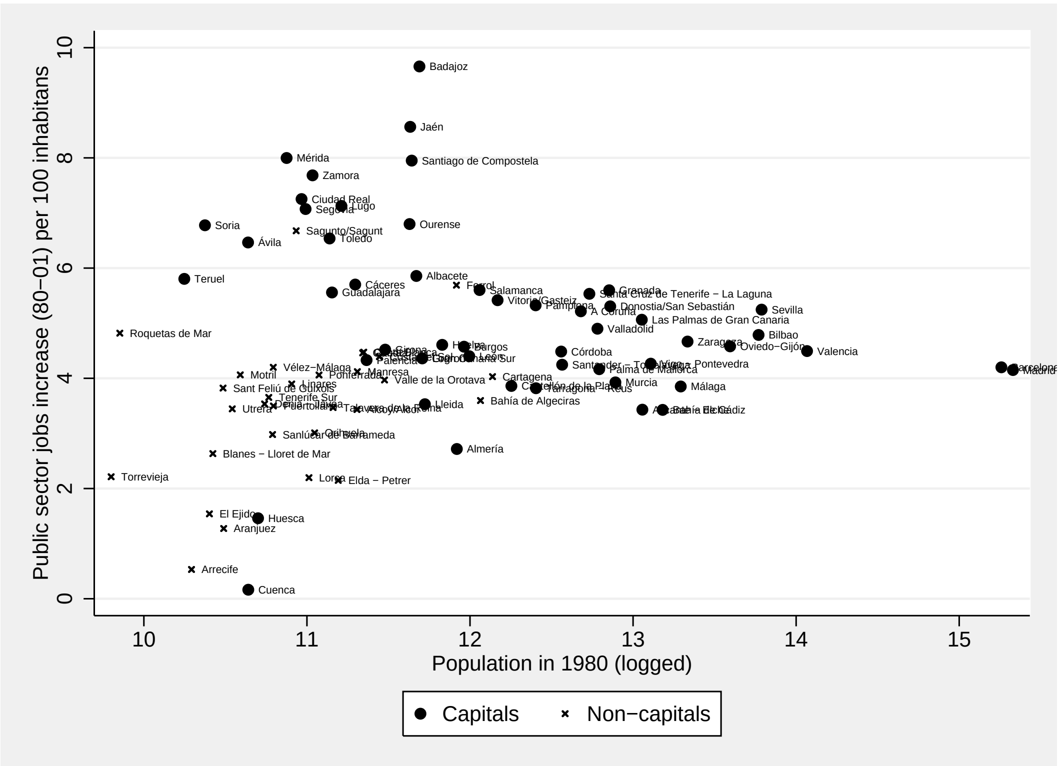
[28] These two cities are historically important. Mérida was the capital of the Roman Lusitania province and Santiago is the destination of a major Catholic pilgrimage route. Moreover, these are the third cities in two bicephalic regions: Galicia (La Coruña and Vigo) and Extremadura (Cáceres and Badajoz).

Figure 2: Public sector employees in 2001 per 100 inhabitants



Source: Census and own elaboration.

Figure 3: Public sector job increase between 1980 and 2001 per 100 inhabitants



Source: Census and own elaboration.

Table 7: Public sector jobs in capital versus non-capital cities (per 100 inhabitants)

	2001		1980-2001	
	Capital	Non-capital	Capital	Non-capital
Public sector	11.120	6.320	5.140	3.550
Public administration	4.530	2.390	2.060	1.460
Education	3.170	1.950	1.510	0.850
Health	3.420	1.970	1.560	1.240

employment expansion in the period 1980-2001. Specifically, we run regressions of the following type:

$$\frac{E_{g,t+10} - E_{g,t}}{Pop_t} = \alpha_t + \beta \cdot Capital + \delta z + \epsilon_t \qquad (34)$$

where the left-hand side variable is the decadal increase in public sector jobs (1980-1990 or 1990-2001) relative to the population level in the base year (1980 or 1990)[29]. In turn, α_t is a set of time dummies while $Capital$ is an indicator variable for capital cities. Finally, z contains some control variables that we consider in some of the specifications. The results are reported in Table 8.

The first column shows the results with no other control variables than time dummies. These estimates indicate that, in the period 1980-2001, being a capital implied an additional 0.7 public workers each decade for every 100 inhabitants in the city in the base year. In the second column, we also consider population growth as a control variable despite its endogenous nature (public sector jobs might increase population as the model developed above predicts). When doing so, the capital effect increases, implying that being a capital is associated with 1.1 extra public jobs for every 100 inhabitants each decade. To assess the relative magnitude of this effect, note that the population growth coefficient (0.036) indicates that an increase of 100 residents is associated with an increase of 3.6 public sector workers. As explained above, there is ample evidence from different countries indicating public employment is used to offset local labor demand shocks. To test if this has also been the case in our application, in the last specification (column 3), we include a Bartik (1991) shift-share variable that captures demand driven private employment changes in city:

$$\frac{\overline{E_{p,t+10}} - E_{p,t}}{Pop_t} = \frac{\sum_h \left(\frac{E_{h,t}}{E^{\tilde{N}}_{h,t}} E^{\tilde{N}}_{h,t+10} - E_{h,t} \right)}{Pop_t}, \qquad (35)$$

where E_p stands for private employment (the sum of tradable and non-tradable workers), h

[29]This variable will become the main explanatory variable in the next section when we turn to the multiplier effects of public employment. Its summary statistics are provided in the third panel (last row) of Table 5.

indexes the (2-digit) industries within the private sector while $\widetilde{N}$ denotes national employment levels. The predicted employment change in equation 35 captures the component of the 1980-1990 and 1990-2001 local employment shock explained by the city's industry mix in the base year (1980 or 1990) interacted with the decadal (1980-1990 or 1990-2001) fate of industries at the national level. The results indicate that for each job lost as a result of a demand shock in a city, the public sector has created 0.194 jobs in the public sector in that city. This provides direct evidence that public employment has been used as a prominent policy instrument to offset local economic shocks. Note that these policy responses are important since they will bias downwards the OLS estimates in the regressions (which we turn to next) that estimate the effect of public employment on local private employment. As for the capital variable, the results of this last specification are slightly higher, implying that capital cities gained 1.6 additional public sector jobs per decade for every 100 inhabitants in the period 1980-2001.

Table 8: The determinants of public sector job increases

	(1)	(2)	(3)
Capital	0.007***	0.011***	0.016***
	(0.002)	(0.002)	(0.003)
Population growth		0.036***	0.042***
		(0.007)	(0.008)
$\frac{\overline{E_{p,t+10}}-E_{p,t}}{Pop_t}$			-0.194***
			(0.060)
R-squared	0.041	0.119	0.165
Observations	166	166	166

Notes: 1) 1980-1990 and 1990-2001 pooled observations 2) Robust standard errors clustered at the city-level in parentheses. 3) *** denotes statistical significance at the 1% level. 4) Population growth is the contemporaneous decadal population growth rate. 5) The last explanatory variable, the private job changes' predictor, as defined in equation 35.

4.3 Public employment multipliers: OLS estimates

We now turn to the estimation of public sector employment multipliers. Specifically, we estimate the impact of (decadal) changes in public employment on contemporaneous changes in measures of employment and population. All employment and population changes are divided by the city's population level at the beginning of the decade. We run variants of the following specification.

$$\frac{Y_{t+10}-Y_t}{Pop_t} = \mu_t + \gamma \frac{E_{g,t+10}-E_{g,t}}{Pop_t} + \eta\, x_t + \zeta_t, \tag{36}$$

where Y stands for tradable, non-tradable and total employment, and active, working age, and total population. In addition to the change in public employment (E_g), the specification includes time dummies (μ_t), a vector containing control variables (x_t) and the error term (ζ_t). The results are reported in Table 9 where each row shows the effect of a public sector job increase on a different outcome. The first column shows the results of specifications that only include the time dummies as controls. In the second column, we also include the unemployment rate and the share of college graduates measured at the beginning of the decade. Some of the cities in our sample are fast-growing coastal cities associated with tourism, such as Torrevieja, Costa del Sol or Tenerife Sur. Thus, in the third column we also include the share of vacation homes in 1991 as well as two coastal indicators: one for the North Atlantic coast (*Mar Cantábrico*) with less tourism and one for the coasts of the Mediterranean, the Andalusian Atlantic and the Canaries coasts. Finally, as commented previously, when describing the summary statistics in Table 5, there is mean reversion in population growth. Hence, in column 4, we include a second order polynomial of the (logged) population level in 1970. The summary statistics for these controls are provided in the bottom panel of Table 5.

Table 9: Public employment multipliers: OLS estimates

Outcomes:	1	2	3	4
a)Tradable employment	0.087	0.116*	0.101	0.102
	(0.073)	(0.060)	(0.064)	(0.064)
b) Non-tradable employment	0.545***	0.649***	0.602***	0.614***
	(0.156)	(0.145)	(0.134)	(0.133)
c) Total employment	1.632***	1.765***	1.703***	1.716***
	(0.183)	(0.164)	(0.160)	(0.160)
d) Active population	1.780***	1.940***	1.853***	1.862***
	(0.211)	(0.185)	(0.168)	(0.169)
e) Working age population	0.938**	1.117***	0.865***	0.865***
	(0.438)	(0.421)	(0.334)	(0.295)
f) Population	1.679***	1.875***	1.447***	1.458***
	(0.573)	(0.576)	(0.456)	(0.452)
Unemployment rate	N	Y	Y	Y
Share of college graduates	N	Y	Y	Y
Coastal dummies	N	N	Y	Y
Share of vacation-homes in 1991	N	N	Y	Y
Logged pop in 1970 (2nd order pol.)	N	N	N	Y
N	166	166	166	166

Notes: 1) 1980-1990 and 1990-2001 pooled observations 2) Robust standard errors clustered at the city-level in parentheses. 3) ***,** and * denote statistical significance at the 1, 5 and 10% level. 4) Unemployment rate and share of college graduates measured at the beginning of the decade. 5) Coastal dummies include two dummies: One for the North Atlantic coast (*Cantábrico*) and one for the coasts of the Mediterranean, the Atlantic in Andalusia and the Canaries coasts.

Focusing on the last, and more complete, specification, the results indicate that public sector jobs do not significantly increase nor decrease employment in the tradable sector. In contrast, the results reported in the second row indicate that one additional job in the public sector creates more than 0.6 jobs in the non-tradable sector. The effect on total employment (third row) is about 1.7 which includes the public job being created and the additional positive effect on private employment. Across the different model specifications, the results do not undergo any major changes. As for population, the results indicate that creating public sector jobs increases the active, the working age and total population, suggesting that taking geographical mobility into account might be important when assessing the local labor market effects of the expansion of public employment.

As revealed by the analysis of the determinants of the expansion of the public sector in Table 8, the public sector used its job openings to offset negative private employment shocks. These policy responses tend to underestimate the (OLS) coefficients presented in Table 9. On the other hand, however, we have seen that cities that grow more hire more public employees (probably) to provide public services to a larger population. Since growing cities are likely to create more private as well as public jobs, this will lead to a tendency to over-estimate the effect of public employment on private jobs. Hence, the estimates provided in this section may be either under- or over-estimates of the effect of public sector expansions on private employment and population. Thus, to circumvent these endogeneity concerns, we now turn to the TSLS analysis.

4.4 Public employment multipliers: TSLS estimates

We have seen above that Spain's capital cities (as opposed to non-capital cities) experienced larger increases in public sector employment as the public sector developed in the period 1980-2001. This observation form the basis of the instrumental variables approach that we now adopt which involves using the capital status of a city to instrument for changes in public employment relative to the population level in the base year. Table 10 reports the TSLS estimates of equation 36 and shares the same structure as Table 9. That is, each row shows the public employment coefficient on an employment or a population outcome. In terms of control variables, the first column corresponds to the specification reported in the last column of Table 9. This baseline specification includes time dummies, the unemployment rate and the share of college graduates at the beginning of the decade, the tourism variables (the coast indicators and the share of vacation-homes in the city), and the 2nd order polynomial of the (logged) population level in 1970.

In the case of the second stage results, the tradable employment coefficient is not statistically different from zero although the point estimate is larger than its OLS counterpart. Jobs in the non-tradable sector increase in a city when public sector jobs are created. Specifically, a new job in the public sector creates about 1.1 jobs in the non-tradable sector. Considering the direct jobs created in the public sector, the effect on total employment is about 2.3 (row c). The effects

Table 10: Public employment multipliers: TSLS estimates

	1	2	3	4	5
a) Tradable employment	0.267	0.314	0.364	0.351	0.287
	(0.294)	(0.319)	(0.337)	(0.329)	(0.314)
b) Non-tradable employment	1.078***	1.259***	1.404***	0.861***	1.020**
	(0.415)	(0.489)	(0.449)	(0.325)	(0.416)
c) Total employment	2.344***	2.573***	2.769***	2.129***	2.307***
	(0.571)	(0.666)	(0.638)	(0.447)	(0.588)
d) Active population	2.695***	2.967***	3.156***	-	2.667***
	(0.672)	(0.778)	(0.713)		(0.681)
e) Working age population	4.443***	4.983***	5.148***	-	4.265***
	(1.463)	(1.678)	(1.510)		(1.442)
f) Population	6.356***	7.062***	7.037***	5.820***	6.257***
	(2.027)	(2.357)	(2.196)	(2.174)	(2.034)
Unemployment rate	Y	Y	Y	Y	Y
Share of college graduates	Y	Y	Y	Y	Y
Tourism variables	Y	Y	Y	Y	Y
2^{nd} order logged pop. polynomial	Y	Y	Y	Y	Y
Weather	N	Y	N	N	N
Regional fixed effects	N	N	Y	N	N
Lagged dependent variable	N	N	N	Y	N
Motorways	N	N	N	N	Y
F-test of excluded instruments	15.750	15.160	15.010	-	14.340
N	166	166	166	166	166

Notes: 1) 1980-1990 and 1990-2001 pooled observations 2) Robust standard errors clustered at the city-level in parentheses. 3) ***,** and * denote statistical significance at the 1, 5 and 10% level. 4) Unemployment rate and share of college graduates measured at the beginning of the decade. 5) Coastal dummies include two dummies: One for the North Atlantic coast (*Cantábrico*) and one for the coasts of the Mediterranean, the Atlantic in Andalusia and the Canaries coasts. 6) Weather includes annual days of frost, hours of sun and rainfall. 7) Regional fixed effects for the 7 NUTS1 Spanish regions. 8) The estimates for active population and working age population not shown in the specification with lagged dependent variables as these outcomes are not available for 1970. For this specification, the F-statistic is not reported as for each outcome it takes a different value 9) Motorways is the decadal contemporaneous increase in the number of motorway rays.

on population are sizable, too. One job in the public sector increases the city's labor force by 2.7 workers (row d) and the working age population by 4.4 (row e). Finally, the coefficient on total population is around 6.4, indicating that city size is very responsive to the creation of public sector jobs (row f). Note that the TSLS (positive) estimates of public employment on total employment and on population are larger than their corresponding OLS estimates. This suggests that the latter are downwards biased and confounded by the strong policy responses consisting in offsetting negative shocks in private employment by opening public sector jobs.

The effects of public employment on both private employment and on population are relatively large, at least, compared to the results reported for England by Faggio and Overman (2014). There are, at least, three factors that can account for the size of the multipliers that we estimate.

First, as explained above, interregional migration rates have been relatively low in Spain between 1980 and 2001 but, in contrast, intraregional migration rates have been substantial (Bover and Arellano, 2001). Second, the model simulations indicate that land supply elasticity is key to determining if, and the extent to which, public employment crowds-in or crowds-out private employment. As can be seen in Figure 3, the complier cities in our TSLS regressions are relatively small provincial capitals which can be considered to be cities with a rather elastic land supply. Finally, the model simulations indicate that multipliers will be larger when public sector wages are high. In Spain, the public sector wage gap is substantial (Hospido and Moral-Benito, 2014), and this is especially true in small provincial capitals given that the distribution of public sector wages is more compressed than that of the private sector.

For the estimates in Table 10 to be reliable, the instrument used needs to be both relevant and valid. In terms of relevance, the estimates in Table 8 indicate that, indeed, capital cities attracted more public sector jobs. According to the results in the last column, capital cities gained 1.6 additional public sector jobs per 100 inhabitants each decade in the period 1980-2001. To assess instrument relevance more formally, at the bottom of Table 10, we report the F-test of excluded instruments. The value of the F-test, obtained in a regression where the standard errors are clustered at the city-level, is 15.8 and corroborates that, indeed, the capital cities attracted more public sector jobs. In fact, the instrument coefficient in the first stage regression is 0.017 which is very close to 0.016, the estimate obtained in the last specification of Table 8.

As for instrument validity, the identifying assumption is that, conditional on control variables, the capital status of a city is uncorrelated to unobserved shocks in employment and population decadal changes. As explained above, the provincial capitals were established in 1833 and, therefore, are clearly pre-determined with respect to our outcome variables. However, the capital cities differ from non-capital cities in several respects. Capital cities have a lower unemployment rate (the average unemployment rate -pooling 1981 and 1991- is 16.9 and 20.0 for capital and non-capital cities) and a larger fraction of college graduates (the average share of college graduates -pooling 1981 and 1991- is 9.7 and 5.8 for capital and non-capital cities). As Figure 1 shows, capital cites are also less likely to be on the coasts of the Mediterranean and Canaries' coasts and, finally, capital cities are larger as can be readily seen in Figure 2. Although including these controls had a modest impact on the OLS coefficients (see Table 9), their exclusion does confound the TSLS estimates. Thus, our identifying assumption is that capital status is uncorrelated to shocks in employment and population changes once we control for initial unemployment, education, location (coast versus inland) and size. Note that these city features are observables that confound our estimates when they are omitted as controls. Hence, there might be city unobservables that are actually confounding our findings. In what follows, we address a number of threats to identification.

In the US, weather has been an important determinant of city growth with cities in the sun belt performing especially well, see e.g. (Rappaport, 2007). Thus, in column 2 of Table 10 we include city-level weather controls. Specifically, we consider the city's annual averages for days of frost, hours of sun and rainfall[30]. The results remain unchanged indicating that a correlation between weather and capital status is not confounding our estimates.

As explained above, capital cities are less likely to be on the coasts of the Mediterranean and Canaries' coasts. More generally, Figure 1 also reveals that while capitals are evenly distributed across Spain, non-capitals are concentrated in the east and the south-east. Since the east has performed particularly well in the period of study, the results could be biased by the fact that regions performing better have a higher proportion of non-capital cities. Thus, in column 3, we include dummies for the 7 (broad) NUTS1 Spanish regions[31]. The results, that exploit changes between cities within regions remain largely unchanged and indicate that regional specific trends in employment and population do not seem to be driving the results.

In column 4 we move to city-specific pre-treatment trends in employment and population. Specifically, we include, as an additional control variable, the lagged dependent variable (1970-1980 and 1980-1990 values for the 1980-1990 and 1990-2001 observations, respectively). Since the active and the working-age population for 1970 are not available, we cannot estimate this specification for rows d) and e). Reassuringly, our estimates do not undergo any significant changes suggesting that our results are not driven by pre-existing city-specific time trends.

Finally, in the period that we study, Spain developed a large motorway network that has been found to affect city growth, see, e.g. (Garcia-López (2012) and Garcia-López et al. (2015)). Since the network might have provided better connections to capital cities, in column 5 we include, as an additional control variable, the decadal contemporaneous increase in the number of motorway rays in the city[32]. The results suggest that the positive effects that we document from public sector jobs on private employment and population do not capture higher infrastructure investments in capital cities. Overall, once we account for basic differences across cities in terms of unemployment, education, location (coastal vs. non-coastal cities) and size, the results do not seem to be sensitive to a number of robustness checks.

We conclude this section by comparing the estimated multipliers with those obtained when simulating the search and matching model in section 3. According to the regressions, one additional public sector job increases private employment by about 1.3 and active population by 2.7. The corresponding multipliers found in section 3 (Table 2) were about 1.3 and 2.6, respectively. Admittedly, the multipliers for the tradable sector are less similar although not statistically dif-

[30] *Agencia Estatal de Metereología*. 1980-2010 averages. There are a handful of cities without a climate observatory. For these cities, we impute the values of the closest observatory.

[31] North west: Galicia, Asturias and Cantabria; North East: Basque Country, Navarre, La Rioja, Aragon; Madrid; Centre: Castile and Leon, Castile-la Mancha, Extremadura; East: Catalonia, Valencian Community and Balearic Islands; South: Andalusia, Region of Murcia; Canary Islands.

[32] Number of motorway rays in each city computed using the *Mapa General de Carreteras - Ministerio de Fomento* from the years 1980, 1990 and 2001.

ferent from each other. While the multiplier is -0.012 according to the simulated model, the corresponding TSLS (point) estimate is 0.267. All in all, the empirical findings provided by the two empirical approaches yield remarkably similar results and, thus, the two approaches cross-check each other.

4.5 Do public sector jobs reduce local unemployment?

The regression results obtained above clearly indicate that public sector jobs do increase private employment. However, they also show that population increases too and, thus, the effect on the unemployment rate is not obvious. To assess the implied effects on the unemployment rate of the estimates presented in Table 10, we take the average Spanish city in 2001 and assume that public employment increases by 50%, which is the policy experiment that we have simulated with the calibrated model in section 3. The findings are reported in Table 11.

Table 11: Local labor market effects of public sector job expansions

Variables	Mean 2001	Multiplier	New Equilibrium	% Change
Total employment	119,700	2.344	154,262	28.874
Active population	141,829	2.695	181,567	28.018
Working age pop.	228,056	4.443	293,568	28.726
Population	330,320	6.356	424,039	28.372
Unemployment rate	0.156		0.150	-0.560^{a}
Participation rate	0.622		0.618	-0.340^{a}
Public employment	29,489		44,234	50.000

Notes: 1) The new equilibrium is the result of adding to the 2001 mean, the respective multiplier times 14,745 (a 50% increase in public employment starting from 29,489 jobs). The last two columns (shown for ease of comparison) show the baseline simulations reported in Table 2. 2) ^{a} are changes expressed in percentage points.

Column 2 of Table 11 reproduces the estimated multipliers reported in the first column of Table 10. The new equilibrium is the result of adding to the 2001 mean, the respective multiplier times 14,745, which is a 50% increase in public jobs for the average city in 2001. Increasing public employment by 50% increases total employment by 28.9%. At the same time, however, the active population grows at a similar rate (28.0%) and, as a result, the unemployment rate experiences a slight decrease. Specifically, it only falls from 0.156 to 0.150. These results are, again, very similar to those predicted by the simulations in section 3. In the baseline scenario (Table 2), increasing public employment by 50% increases total employment and active population by 27.8% and 26.7%, respectively, with the unemployment rate falling from 0.156 to 0.149.

The results presented in Table 11 also allow us to quantify the effects of public employment on the working-age population. As explained above, an important trend in the Spanish labor market in the period studied was the marked increase in female labor force participation. Our estimated effects on the active and the working-age city-level populations suggest that this was not the case. Specifically, public sector jobs increase the labor force and the working-age population in similar proportions and, as a consequence, participation in the labor market remains largely unaltered. All in all, migration (rather than labor-force participation) seems to be the main margin through which local labor markets adjust to public sector job expansions.

5 Summary and final remarks

In this paper we have quantified the impact of public employment on Spanish local labor markets in the long-run by adopting two quantitative approaches. In the first, we developed a 3-sector (public, tradable and non-tradable) search and matching model embedded within a spatial equilibrium model in the spirit of Beaudry et al. (2012) and Kline and Moretti (2013). We characterized the steady state of the model and calibrated it. We then used the model to simulate a policy consisting in expanding public sector employment in a city. To the best of our knowledge, we are the first to use a calibrated search and matching model to study the effect of a local labor market policy in the context of open cities. Variants of the quantitative approach developed here might be well suited for evaluating labor market and regional policies when local unemployment is an important policy target or outcome of interest.

In the second approach, we have used regression analysis to estimate the impact of public sector job growth on decadal changes (1980-1990 and 1990-2001) in the employment and population of Spanish cities. This analysis exploited the dramatic increase in public employment in the period 1980-2001, following Franco's death in 1975 and the advent of democracy in 1978. We resorted to an instrumental variables approach that used the capital status of cities to instrument for changes in public sector employment.

The two empirical approaches yield qualitatively similar results and, thus, cross-check each other. One additional public sector job creates about 1.3 extra jobs in the private sector. However, these new jobs do not translate into a substantial reduction in the local unemployment rate as better labor market conditions attract new workers to the city. Increasing public employment by 50% only reduces unemployment by 0.6 percentage points (from 15.6 to 15%). An important message to be derived from this paper is that taking geographical mobility into account can be crucial for proper evaluation of the equity and efficiency of regional and local policies, as emphasized by Kline and Moretti (2013) and Glaeser and Gottlieb (2008) when assessing the rationale for place-based initiatives.

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A Appendix: Nash bargaining

A.1 Tradable sector

$$\max_{w}(W_t - U)^{\beta}(J_t - V_t)^{1-\beta}, \tag{A-1}$$

$$rV_t = 0. \tag{A-2}$$

Then the FOC's

$$\beta(W_t - U)^{\beta-1}\frac{dW_t}{dw_t}J_t^{1-\beta} + (W_t - U)^{\beta}(1-\beta)\frac{dJ_t}{dw_t}J_t^{-\beta} \;=\; 0, \tag{A-3}$$

$$\beta(W_t - U)^{-1}\frac{dW_t}{dw_t}J_t \;=\; -(1-\beta)\frac{dJ_t}{dw_t}, \tag{A-4}$$

$$\beta\frac{dW_t}{dw_t}J_t \;=\; -(W_t - U)(1-\beta)\frac{dJ_t}{dw_t}. \tag{A-5}$$

From equations 3 and A-2:

$$J_t \;=\; \frac{A_t(L) - w_t}{r + s_t}, \tag{A-6}$$

then,

$$\frac{dJ_t}{dw_t} \;=\; \frac{-1}{r + s_t}. \tag{A-7}$$

Subtracting rU from both sides of equation 10

$$r(W_t - U) \;=\; \frac{w_t}{P} + s_t(U - W_t) - rU, \tag{A-8}$$

operating,

$$(W_t - U) = \frac{\frac{w_t}{P} - rU}{r + s_t}, \tag{A-9}$$

then,

$$\frac{dW_t}{dw_t} = \frac{\frac{1}{P}}{r + s_t}. \tag{A-10}$$

Substituting equation A-7 and A-9 in A-5 we obtain equation 13,

$$\frac{1}{P}\beta J_t = (1-\beta)(W_t - U). \tag{A-11}$$

A.2 Non-tradable sector

$$\max_w (W_n - U)^\beta (J_n - V_n)^{1-\beta}, \tag{A-12}$$

$$rV_n = 0, \tag{A-13}$$

Then the FOC's

$$\beta(W_n - U)^{\beta-1}\frac{dW_n}{dw_n}J_n^{1-\beta} + (W_n - U)^\beta(1-\beta)\frac{dJ_n}{dw_n}J_n^{-\beta} = 0, \tag{A-14}$$

$$\beta(W_n - U)^{-1}\frac{dW_n}{dw_n}J_n = -(1-\beta)\frac{dJ_n}{dw_n}, \tag{A-15}$$

$$\beta\frac{dW_n}{dw_n}J_n = -(W_n - U)(1-\beta)\frac{dJ_n}{dw_n}, \tag{A-16}$$

From equations 4 and A-13:

$$J_n = \frac{p_n A_n - w_n}{r + s_n}, \tag{A-17}$$

then,

$$\frac{dJ_n}{dw_n} = \frac{-1}{r+s_n}. \tag{A-18}$$

Subtracting rU from both sides of equation 11

$$r(W_n - U) = \frac{w_n}{P} + s_n(U - W_n) - rU, \tag{A-19}$$

operating,

$$(W_n - U) = \frac{\frac{w_n}{P} - rU}{r+s_n}, \tag{A-20}$$

then,

$$\frac{dW_n}{dw_n} = \frac{\frac{1}{P}}{r+s_n}. \tag{A-21}$$

Substituting equation A-18 and A-20 in A-16 we obtain equation 14,

$$\frac{1}{P}\beta J_n = (1-\beta)(W_n - U). \tag{A-22}$$

B Appendix: Wage equations

To obtain the wage equations 24 and 25 we start using the first order conditions 22 and 23. Next, we solve for J_t in 3 and J_n in 4

$$J_t = \frac{A_t(L) - w_t}{(r+s_t)}, \tag{A-23}$$

$$J_n = \frac{p_n A_n - w_{nt}}{(r+s_n)}. \tag{A-24}$$

Notice that the job creation conditions 22 and 23 are obtained by using A-23, A-24, 1, 2 and the free entry conditions 5 and 6.

Then, we solve for $W_t - U$ and $W_n - U$ in using 8, 10 and 11,

$$(W_t - U) = \frac{\frac{w_t}{P} - rU}{(r + s_t)}, \tag{A-25}$$

$$(W_n - U) = \frac{\frac{w_n}{P} - rU}{(r + s_n)}. \tag{A-26}$$

Now substitute A-23, A-24, A-25 and A-26 in 13 and 14 and solve for w_t and w_n

$$w_t = \left(\frac{\beta A_t(L)}{P} + (1-\beta)rU\right)P, \tag{A-27}$$

$$w_n = \left(\frac{\beta p_n A_n}{P} + (1-\beta)rU\right)P. \tag{A-28}$$

To obtain rU we use equations 8, 22 and 23 and substitute $J_i = \frac{k_i}{q(\theta)}$ in 13 and 14,

$$(W_t - U) = \frac{\beta}{(1-\beta)} \frac{k_t}{q(\theta)P}, \tag{A-29}$$

$$(W_n - U) = \frac{\beta}{(1-\beta)} \frac{k_n}{q(\theta)P}. \tag{A-30}$$

Next, we obtain $W_g - U$ using 8 and 9

$$(W_g - U) = \frac{\frac{(w_g - b)}{P} - f_t(W_t - U) - f_n(W_n - U)}{(r + s_g + f_g)}. \tag{A-31}$$

Finally, knowing that $\frac{f}{q(\theta)} = \theta$, we substitute A-29, A-30 and A-31 in 8 and obtain

$$rU = \frac{1}{P}\left[b + f_g\left[\frac{(w_g - b - \frac{\beta\theta}{(1-\beta)}(\Omega_t k_t + \Omega_n k_n))}{(r + s_g + f_g)}\right] + \frac{\beta\theta}{(1-\beta)}(\Omega_t k_t + \Omega_n k_n)\right]. \tag{A-32}$$

By substituting A-32 into A-27 and A-28 we obtain the wage equations 24 and 25.